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Branas-Garza, Pablo and Smith, John (2016) Cognitive abilities and economic behavior. Journal of Behavioral and Experimental Economics, 64 . pp. 1-4. ISSN 2214-8043 [Article] (doi:10.1016/j.socec.2016.06.005)

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Cognitive abilities and economic behavior*

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June 6, 2016

1 Introduction¹

At the heart of behavioral and experimental economics is the goal to better understand behavior through observation so that economic models can be improved. However, despite the predictions of classical economics, the researcher is often confronted with a great deal of behavioral heterogeneity. One way to approach this heterogeneity is to acknowledge that decision makers differ from each other in fundamental ways and these differences contribute to the differences in observed economic behavior.

Advances have been made in understanding strategic behavior by studying the existence and implications of behavioral heterogeneity in games.² A different strand of literature seeks to better understand the heterogeneous cognitive processes that underlie economic behavior.³ However, another strand of literature explores whether the observed heterogeneity is associated with the cognitive ability of the subjects. As such, many researchers have examined the

*We are grateful to more than 50 referees who provided very insightful comments and suggestions on the original submissions and subsequent revisions of the articles included in this special issue. Ofer Azar provided helpful comments on this introduction.

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¹It is beyond the scope of this introduction (and this Special Issue) to provide a thorough review of the literature on cognitive abilities and economic behavior. However, we note that the literature has progressed to the point that an exhaustive review that is designed for economists would be helpful. See Rustichini (2015) for a literature review designed for non-economists.

²Camerer et al. (2004), Costa-Gomes et al. (2001), Costa-Gomes and Crawford, (2006), Costa-Gomes and Weizsacker (2008), Crawford et al. (2013), McKelvey and Palfrey (1995), Nagel (1995), Rey-Biel (2009), Slonim (2005), Stahl and Wilson (1994), Stahl and Wilson (1995), Weber (2001), and Weber (2003).

³Agranov et al. (2015), Agranov et al. (2012), Allred et al. (2014), Burchardi and Penczynski (2014), Cappelletti et al. (2011), Coricelli and Nagel (2009), Coricelli and Nagel (2012), Crawford (2008), Duffy and Smith (2014), Schulz et al. (2014), and Wang et al. (2010).

relationship between a measure of the cognitive ability of the subject and their economic behavior.⁴

2 This Special Issue

In this Special Issue (SI), we offer twelve papers that exemplify cutting edge research on cognitive abilities and economic behavior. In particular, these papers improve our understanding of economic behavior by considering the role of cognitive ability. Despite this common goal, the papers contained in this SI are heterogenous. For instance, the papers contained in this SI study economic behavior in a variety of settings (strategic and non-strategic, field studies and laboratory studies, etc.).

At the outset, we declare that the term *cognitive ability* is used here (and throughout the SI) in a broad sense. The measures of cognitive ability include well-known measures, such as the Cognitive Reflection Test (CRT; Frederick, 2005)⁵ and the Raven Progressive Matrices (Raven, 1936; Raven, Raven and Court, 2000). On the other hand, papers in this SI also employ less-standard measures of cognitive ability, including success at a strategic board game (Baghestanian and Frey, 2016), a working memory test and an arithmetic test (Prokosheva, 2016), Faith in Intuition (Alós-Ferrer and Hügelschäfer, 2016), the Red Hat puzzle (Bayer and Renou, 2016a), and success in the Hit 15 game (Rustichini, DeYoung, Anderson, and Burks, 2016).

We have organized the SI in the following manner. The first six papers focus on the question of how measures of cognitive abilities are related to behavior in relatively simple

⁴As a non-exhaustive list of references, see Andersson et al. (2016), Ballinger et al. (2011), Bayer and Renou (2016b), Beauchamp et al. (2011), Benjamin et al. (2013), Ben-Ner et al. (2004), Borghans et al. (2008), Brañas-Garza et al. (2012), Brañas-Garza et al. (2011), Brañas-Garza et al. (2008), Brandstätter and Güth (2002), Burks et al. (2009), Burnham et al. (2009), Carpenter et al. (2013), Chen et al. (2013), Chen et al. (2014), Cokely and Kelley (2009), Cubel and Sanchez-Pages (2014), Dave et al. (2010), Devetag and Warglien (2003), Dohmen et al. (2010), Fehr and Huck (2016), Geng et al. (2015), Georganas et al. (2015), Gill and Prowse (2016), Grimm and Mengel (2012), Hanaki et al. (2016), Jones (2008), Jones (2014), Millet and Dewitte (2007), Oechssler et al. (2009), Palacios-Huerta (2003), Palacios-Huerta and Volij (2009), Ponti and Rodriguez-Lara (2015), Proto et al. (2014), Putterman et al. (2011), Rydval and Ortmann (2004), Schnusenberg and Gallo (2011), Shamosh et al. (2008), Shamosh and Gray (2008), Stanovich and West (2008), Taylor (2013), Taylor (2016), and Toplak et al. (2011).

⁵See Toplak et al. (2011) and Brañas-Garza et al. (2016) for meta-analyses. Bosch-Domènech et al. (2014) find that CRT scores are related to fetal exposure to testosterone.

games (prisoner’s dilemma, trust, public goods) or relatively complicated games (bank runs and Schelling games). The last six papers combine a well-known measure of cognitive ability (for instance, the CRT) with a measure that is novel to the economics literature (Faith in Intuition, irreflection, and personality measures).

2.1 Cognitive abilities and behavior in games

We begin with Benito-Ostolaza, Hernández, and Sanchis-Llopis (2016). These authors study the relationship between cognitive ability and behavior in a complicated Schelling game. Benito-Ostolaza et al. find that subjects with a higher measure on the 60 item Raven test also make a larger number of optimal strategic actions. Hence subjects with a higher cognitive ability are more likely to play their Nash Equilibrium strategy.

Kiss, Rodriguez-Lara, and Rosa-García (2016) observe behavior in a sequential bank run game, where it is a dominant strategy for the final player to not withdraw funds. However, the experiment manipulates the extent to which this is transparent to the subject, by implementing a strategic uncertainty treatment and a no strategic uncertainty treatment. The authors find that for subjects in the strategic uncertainty treatment, higher CRT scores are associated with fewer withdrawals. However, in the more transparent treatment, they do not find a relationship between CRT scores and withdrawals. In other words, higher cognitive ability subjects are more strategic than lower cognitive ability subjects, but only in relatively opaque strategic settings.⁶

Whereas the first two papers show that subjects with higher cognitive abilities are more likely to play rationally, the following papers find the opposite in games where behavior is affected by social preferences. For instance, Corgnet, Espín, Hernán-González, Kujal, and Rassenti (2016) measure cognitive ability with the CRT and observe behavior in a trust game. The authors find a positive relationship between cognitive ability and trust, suggesting that higher cognitive ability subjects are more likely to play dominant strategies in the presence of social preferences. However, this relationship does not appear to be driven by preferences toward risk. Further, the authors do not find a relationship between cognitive ability and

⁶Also see Brañas-Garza et al. (2012).

trustworthy behavior.

Lohse (2016) finds that subjects with higher CRT scores contribute more in a one-shot public goods game. In order to better understand this result, the author also employs a computer treatment (where there is not a pro-social benefit from contributing) and a time pressure treatment. The author does not find a relationship between CRT and contributions in either the computer treatment or the time pressure treatment. This suggests that the contributions from the high CRT subjects are deliberative and motivated by social preferences. However, it remains to be seen if the results are due to the preference for efficiency or some other mechanism.

When the experimenter observes behavior in a strategic setting it is often difficult to distinguish among the possibilities that the subject lacked the capacity for strategic thought, that the subject exhibited a lack of sophistication because there was a perceived lack of sophistication of the opponent, or that the subject was affected by social preferences. In response to this, Bayer and Renou (2016a) study a setting in which subjects engage in a strategic interaction with computers programmed to play optimally and the subjects were made aware of this fact. This setting (Red Hat puzzle) avoids both the confounds of the expectation of sophistication of the opponent and the effects of social preferences. The authors vary the complexity of the setting and find that subjects perform better in less complicated strategic settings. It would seem that researchers could employ this technique to measure the strategic skills of subjects in order to better understand their behavior in other settings.

Al-Ubaydli, Jones, and Weel (2016) study the cognitive ability of subjects in a finitely repeated prisoner's dilemma game. Rather than only considering the cognitive ability of the subject, the authors also consider the cognitive ability of the matched pair. Al-Ubaydli et al. do not find a relationship between the subject's cognitive ability and cooperation, however they find a relationship between the cognitive ability of the matched pair and cooperation. This result suggests that high cognitive ability subjects are not necessarily more pro-social, but that high cognitive ability matches are better able to coordinate on cooperation.

2.2 Correlates of cognitive ability with other measures

Alós-Ferrer and Hügelschäfer (2016) study the CRT measure, the less well-known (in economics) Faith in Intuition measure, and their associations with well-known biases. Whereas higher CRT scores imply success in making quantitative responses, Faith in Intuition is a self-reported measure of the subject's disposition toward automatic, rather than reflective, judgments. The authors find that neither measure outperforms the other and that both can be helpful in different settings. The authors challenge researchers to think hard about the specific feature that is being measured by any technique, and to strive for improved techniques. This challenge only becomes more urgent as the efficacy of CRT diminishes with exposure, and many future experimental participants are familiar with the test.⁷

Baghestanian and Frey (2016) study the differences in the predictions of two different measures of cognitive ability in various strategic settings. The authors use a ranking in the board game GO as a measure of strategic ability and the outcomes of the CRT as a measure of analytic ability. The authors find that strategic ability is associated with playing the Nash actions but analytic ability is associated with playing the efficient, cooperative actions. The results of this paper offer a caution to regarding cognitive ability as undifferentiated. Further, their findings offer a challenge to researchers to think more carefully about employing measures of cognitive ability.

Cueva et al. (2016) study CRT outcomes and its relationships with both economic preferences (risk aversion and social preferences) and psychological measures. In addition to simply considering the number of CRT questions correctly answered, the authors also consider the number of CRT questions answered in the intuitive but incorrect manner. The authors refer to subjects that perform well on the CRT as *reflective*, and those that respond with the intuitive but incorrect answer as *impulsive*. The authors find that male subjects tend to be less impulsive.⁸ They also find evidence that reflective subjects exhibit less risk aversion than impulsive subjects; however, this result is sensitive to the elicitation technique. The authors also find evidence that CRT outcomes are related to personality measures. Additionally, the

⁷See Toplak et al. (2011) and Brañas-Garza et al. (2016).

⁸Also see, Brañas-Garza et al. (2016).

authors find a correlation between the CRT outcomes and personality measures, which begs the question of exactly what does CRT measure.

Prokosheva (2016) investigates the relationship between ambiguity aversion and the reduction of compound lotteries, and whether this relationship is affected by the cognitive ability of the subject. The author employs two measures of cognitive ability: a working memory test and an arithmetic test. Similar to the literature, the author finds a relationship between ambiguity aversion and the reduction of compound lotteries. However this relationship is affected by measures of cognitive ability and the presentation of the lotteries. These results suggest that modeling a close relationship between ambiguity aversion and the reduction of compound lotteries could be problematic.

Studies of investment decisions often have the problem that funds available for investment are correlated with both observed and unobserved heterogeneity. However, Insler, Compton, and Schmitt (2016) study a setting in which every student at the United States Naval Academy was offered an extremely low interest rate loan. The setting provides a unique opportunity to study investment decisions when the liquidity constraint is relaxed, regardless of background. The authors employ measures of cognitive ability that are common in the economics literature in addition to personality measures (Myers-Briggs Type Indicator). The authors find that students with higher measures of cognitive ability (CRT, SAT, and GPA) invest more of the borrowed funds and the personality measures are associated with investing decisions.

Finally, Rustichini, DeYoung, Anderson, and Burks (2016) have access to various life outcomes (body mass index, smoking status, credit score, etc.) and laboratory observations (risk aversion, impatience, strategic behavior) of subjects training to become truck drivers.⁹ Here the authors use variables commonly employed by economists (measures of cognitive ability and demographic information) in addition to personality measures that are not often employed by economists. It is perhaps surprising to economists that the authors find that the personality measures are significantly related to the dependent variables, even in specifications that include the standard economics variables. The authors hope that their work will encourage economists to be open to any variable that can be helpful in improving predictions of behavior.

⁹Also see Burks, Carpenter, Götte, and Rustichini (2009, 2012)

3 Discussion

A number of insights are common across the papers in this SI. For instance, subjects with higher measures of cognitive ability are more likely to play Nash Equilibrium in games where behavior is not affected by social preferences. However, the opposite appears to be the case in games where behavior is affected by social preferences. Also, we have seen that measures of cognitive ability are not identical to other inventories. Further, certain measures are correlated with personality types and even with genetic inheritance, although this is perhaps not surprising given that recent papers have shown that preferences are affected by conditions present even before the birth of the subject.¹⁰ We are excited to present this SI of the *Journal of Behavioral and Experimental Economics*, as we expect that the insights contained in these papers will stimulate exciting research in the future.

¹⁰See Brañas-Garza and Rustichini (2011) for a discussion on risk preferences and see Apicella et al. (2015) for an overview of the literature.

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